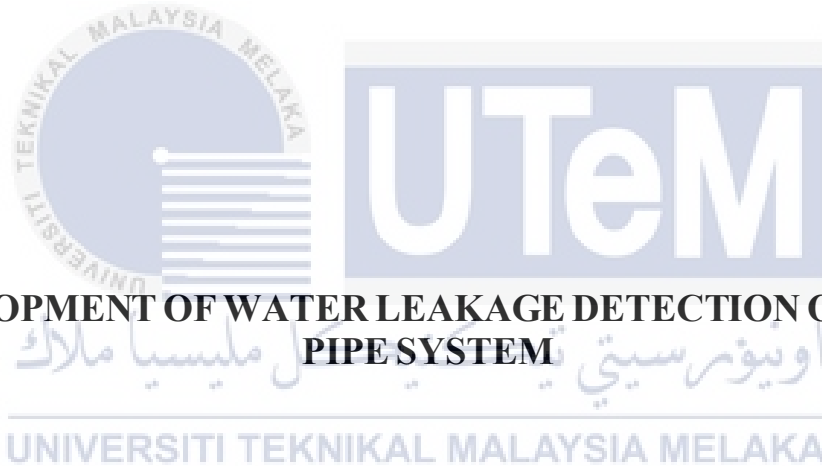




Faculty of Electrical and Electronic Engineering Technology



**DEVELOPMENT OF WATER LEAKAGE DETECTION OF HOUSE
PIPE SYSTEM**

MOHAMAD NAJMI BIN ABDUL NASIR

Bachelor of Computer Engineering Technology (Computer Systems) with Honours

2021

**DEVELOPMENT OF WATER LEAKAGE DETECTION OF HOUSE PIPE
SYSTEM**

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**A project report submitted
in partial fulfillment of the requirements for the degree of
Bachelor of Computer Engineering Technology (Computer Systems) with Honours**



Faculty of Electrical and Electronic Engineering Technology

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2021

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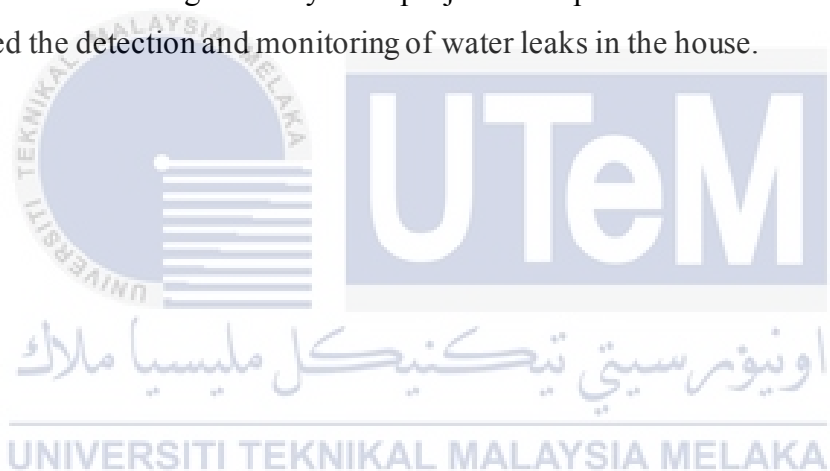
DEDICATION

My dissertation is dedicated to my family and many friends. Mrs. Bedah, my beloved mother, whose words of encouragement and push for persistence continue to echo in my ears. Najwa, Shafira, and Shafikah, my sisters, have never left my side and are very dear to me. This dissertation is also dedicated to my numerous friends who have helped me during the process. I'll be eternally grateful for everything they've done for me, especially Sarah Amira's assistance in developing my hardware and software abilities, and my supervisor's many hours of proofreading report.



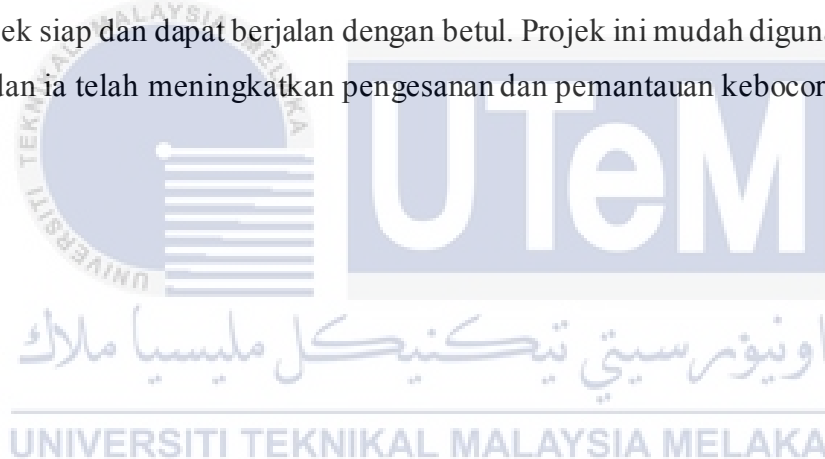
ABSTRACT

Without a doubt, water is the most valuable resource on the planet. However, if there is a potential for a third world war, it will be due to a worldwide water shortage. Therefore, water pipeline monitoring becomes a vital and practical method of preventing massive water waste to avoid such a circumstance. The article's primary goal is to create a leak and water monitoring system based on the Internet of Things (IoT) that will be used to detect leakage of water pipelines in the house. This IoT used a NodeMCU ESP32 as a microcontroller to control the input and output of the system, while Wi-Fi. Two sensors will be used: a flow sensor for the rate of a flow sensor. The observation will be made when the project is completed and can running correctly. This project is simple to use and user-friendly, and it has improved the detection and monitoring of water leaks in the house.



ABSTRAK

Tidak dinafikan, air adalah sumber yang paling berharga di planet ini. Walau bagaimanapun, jika terdapat potensi untuk perang dunia ketiga, ia akan disebabkan oleh kekurangan air di seluruh dunia. Oleh itu, pemantauan saluran paip air menjadi kaedah penting dan praktikal untuk mencegah pembaziran air besar-besaran untuk mengelakkan keadaan sedemikian. Matlamat utama artikel itu adalah untuk mencipta sistem pemantauan kebocoran dan air berdasarkan Internet of Things (IoT) yang akan digunakan untuk mengesan kebocoran saluran paip air di dalam rumah. IoT ini menggunakan NodeMCU ESP32 sebagai mikropengawal untuk mengawal input dan output sistem, manakala Wi-Fi. Dua penderia akan digunakan: penderia aliran untuk kadar penderia aliran. Pemerhatian akan dibuat apabila projek siap dan dapat berjalan dengan betul. Projek ini mudah digunakan dan mesra pengguna, dan ia telah meningkatkan pengesanan dan pemantauan kebocoran air di dalam rumah.



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LIST OF ABBREVIATIONS

<i>L</i>	-	Litres
min	-	Minutes



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INTRODUCTION

1.1 Background

Small and medium-sized leaks in residential plumbing are frequently disregarding even though they can dramatically increase household water demand. Leaks from dripping taps and toilet cisterns can go undetected below ground. Leaks can seem negligible when considered individually, but they result in a substantial water loss when considered collectively over time. Depending on the type and size of the leak, the rate of water loss can vary. In recent years, Malaysian water authorities have expressed concern about long-term water management [18] due to high records of NRW rates. Pipe materials exacerbate water loss, distribution system component joining practices, initial system component installation, water temperatures, and external environmental conditions [15]. Asbestos-Cement (AC), Mild Steel (MS), Ductile Iron (DI), Polyethylene (PE), Galvanized Iron (GI), Acrylonitrile Butadiene (ABS), Cast Iron (CI), and Un-Plasticized Polyvinylchloride (UPVC) are the most popular types of pipes used in Malaysia's water distribution system (uPVC) [14].

Leak detection in water pipelines; pipeline networks carry essential water, oil, and gas. Any pipe leak results in significant financial losses as well as potential environmental harm. Water pipe leaks may allow pollutants to reach water systems, lower water quality, and pose a health risk to water users.

Historically, leak detection has assumed that all leaks come to the surface and are visible. Water distribution infrastructures that are generally old and therefore breakable is the critical cause of leaks. Leaks are difficult to detect because pipes are not readily apparent

and available. Water agencies are forcing to draw more water from lakes and streams due to water supply system losses, placing more stress on aquatic environments. When a leak is discovered, the water company must respond quickly to prevent water loss in the delivery system. These losses are reduced by accurately locating and repairing leaking water pipes in a delivery system. Leaks jeopardize the safety of the water supply network. Households and businesses are forcing to evacuate, pursue alternative sources of potable water, or take other costly steps to protect themselves from the threat of running out of water.

In this project, the water system will be monitor by a device and will alarm the owner to see if the early-stage leaking occurs. The detection device will be enabled to monitor water pipeline leakage every day and anytime. When the leak occurs, it will send the notification through an application to inform the owners about leakages happens.

1.2 Problem Statement

A home's plumbing system is a complex water pipeline network with water supply pipes, drain pipes, and vent pipes. Plumbing due to the convoluted and the high-priced systems to fix or install in a home. These days, a well-designed system will make sure the water flow throughout the pipe system systemically follows the system design. Although the system is systemically correct, can it be repaired and reduced if the leakage happens in the water pipeline?

This project aims to monitor the water pipe system 24 hours a day, seven times a week, by detecting the early stage of leaking and alarming the owner about the leaky, and saving it to the cloud server. The components or hardware used are two water flow sensors, NodeMCU ESP32, and LCD Display. For application for owners to get notifications is Telegram as platform to inform the owners.

The plumber's services will cost a lot if the early-stage leaking is not taken seriously. The water pipeline will affect the water flow when the pipe is connecting. If the owner can be alert when the early leaking occurs, it will reduce the repair of water leaking pipelines. It will also help others to maintain the systemic water flow in the channel.

1.3 Project Objective

This project aims to propose a systematic and practical methodology to alarm the owner of the leakage from water pipelines.

Specifically, the objectives are as follows:

- a) To understand the design water leakage detection in the house when the early stage leaking happens.
- b) To detect the water leakage water leakage pipelines through the difference value of sensors input and output.
- c) To monitor and analyze the pipeline house every time nonstop to ensure no leakage occurs while sending the notifications when leaks happen.

1.4 Scope of Project

The scope of this project is making to inform the features and components used in this project. Among this project's scope is using the NodeMCU ESP32 as microcontroller to control other parts as the head of the project. Next, the water flow sensor will sense the early stage leaking of the water pipeline. When the leaks occur, it will send the notifications to an application for alert the house owner. Finally, owners of the house can prevent the leakages to become more serious in the future.

LITERATURE REVIEW

2.1 Introduction

Nowadays, the waste of water due to leakage in water pipelines in the house is getting worse. The owner must be alarmed when the starting of early leaking to prevent more leakage in the future. The owner needs to pay more for it if the leakage breaks more, then the water will be more waste in the end. The leakages are mending at the early stage to reduce the waste of water. The owner also needs to know which pipe leaks to ease the owner to look up for it. The leakage's sound is analyzing to check whether it early or already harmful leakages on the pipelines.

Some leakages cannot be detected throughout the pipeline. It can waste the water, harm the other household structure, and encourage unwanted organic organisms that grow in the channel. We need to understand and look at how the leakage can happen in the pipeline.

2.2 Pipeline Structure

Figure 2.1 shows the pipeline structure, which includes several branches and nodes. Such a structure may be broken down into its essential components: two units and three nodes [3]. The microcontroller is placed from the sensor placed at each sub-pipe adjacent at the point more pipes branch. The flow sensor will be attached to the microcontroller to collect the data of flow rate.

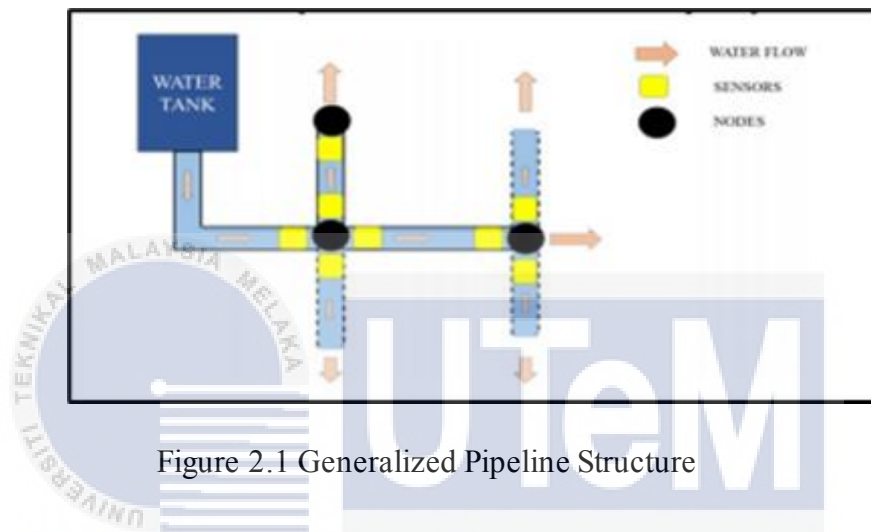


Figure 2.1 Generalized Pipeline Structure

2.2.1 Non-Revenue Water

Many countries around the world are concerned about NRW [7]. High NRW could imply a significant quantity of water loss before it reaches end-users, resulting in higher financial losses. According to the International Water Association (IWA), poor water resource management is one reason for NRW rates [6].

Physical (or actual) losses, commercial (or apparent) losses, and unbilled allowed usage are all components of NRW[6]. Water metering mistakes, billing irregularities, and unlawful consumption, such as water theft, are examples of commercial losses, sometimes known as apparent losses [17]. Water metering errors account for a significant share of commercial losses [6].

Through sophisticated water management systems, Singapore and Japan have significantly reduced their NRW rate [6]. Other research has found that good water management is critical to lowering NRW losses [16]. However, NRW continues to be a problem, particularly in Malaysia. One of the key contributors to this problem is a lack of public knowledge of the severity of the NRW problem and a belief that such a situation is solely the responsibility of the water authorities [1]. Furthermore, the lack of a unified government policy on water security and budget constraints hinders NRW reduction projects' implementation [2]. As a result, it is critical to understand the elements that contribute to NRW so that an effective water management system can limit and regulate the NRW rate.

2.3 Categories of Pipes

There are many different types of plumbing pipes available today, some of which are ancient classics and others built of contemporary materials. When deciding the sort of pipes to utilize in our home's plumbing system, we need to weigh the benefits and drawbacks of each of these materials.

2.3.1 Polyvinyl Chloride Pipes



Figure 2.2 PVC Pipes

Figure 2.2 shows PVC pipe is the most commonly used for draining and vent lines. It has become popular and well-known as a result of its lightweight and ease of use.

Galvanized steel pipe is more difficult to deal with than PVC pipe. It is also quite simple to put together and cut into parts for our purposes. It is simple to glue PVC pipes together, and all that is required is a solvent.

PVC is a low-cost material that used for a long time. Before purchasing a pipe, check the diameter listed on the pipe's surface. PVC cannot be un-connected after it has been connecting, so we will have to cut it. PVC pipes that have been glue together are occasionally prone to leaking.

2.3.2 Cast Iron Pipes



Figure 2.3 Cast Iron Pipes

These plumbing pipes are pricey and have threaded connections. Cast iron pipes are heavier than PVC and other conduits, making them ideal for a water distribution system underground. Because of its robustness and extended life, cast iron pipe makes up most municipal pipelines, as Figure 2.3. Pipes made of cast iron can be utilized until they corrode entirely. These pipes are extremely tough to resize and cut. They are primarily used for gas distribution, drainage, and water distribution. On the other hand, ductile iron pipes have the advantage of a clean tapping procedure utilizing specialist tools, which lowers the need for welding and installation abilities [20].

2.3.3 PEX Pipe



Figure 2.4 PEX Pipe

PEX pipe is a new product on the market, as well as in the plumbing industry. It is purely for water supply. PEX pipe has the benefit of being stiff and durable. It can withstand water pressure. Because it is flexible, it can weave around walls and crawl spaces.

2.3.4 Rigid Copper Pipe



Figure 2.5 Rigid Copper Pipe

Within the home, rigid copper pipe is typically utilized for water supply lines. It is pretty simple to cut. With a hacksaw, it is possible to cut it. A stiff copper pipe connection differs from others in that soldering copper pipes together takes practice. It has no dangerous precautions and is suitable for water supply. The pipe is flexible despite its rigidity. It can tolerate high temperatures and pressure.

2.3.5 Galvanized Steel Pipe



Figure 2.6 Galvanized Steel Pipe

For many years, galvanized steel pipe has been utilized for drainage, water delivery, and gas delivery. It can also be used for other things. However, it is rarely employed in the present era, notably for water delivery in new residences. The threaded ends of the galvanized steel pipes are screwed together using joints. These pipes are pretty durable, but they can corrode and obstruct water flow.

2.4 Causes of Water Pipeline Leakages

A water leak is the last thing any homeowner wants to deal with. Some individuals disregard the signs of a water leak because they are terrified of what they might find if they poke around behind walls and near pipes. Nobody enjoys hearing a leaking faucet drip, drip, drip. Corroded pipes leak, causing a slew of issues for homeowners. Leaks can be as minor as a leak, yet they may also cause significant damage to our house and property.